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THE GEOLOGY OF PERRY TOWNSHIP, LICKING CO., OHIO.

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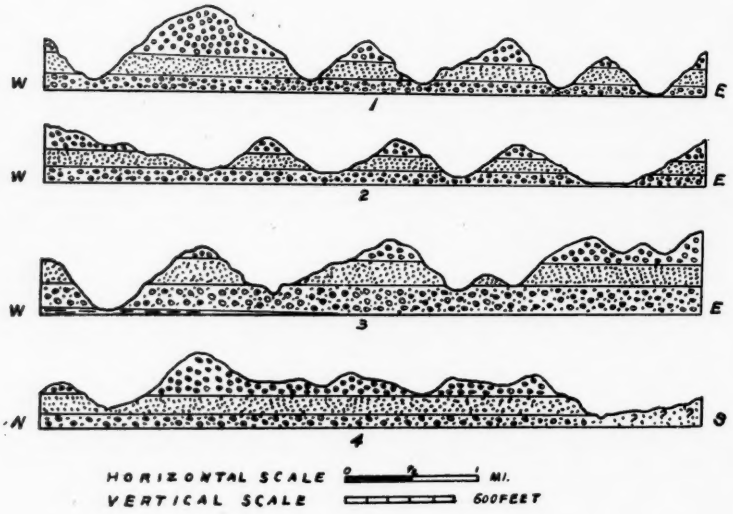
STRATIGRAPHY.

In Perry township but one stream, Rocky Fork, is flowing on rock; and this is rock-floored for less than a mile, presenting at no point a vertical rock section of more than fifteen feet. In the south central part of the township a small tributary of the Wakatomaka creek cascades across the Black Hand conglomerate at a sharp grade exposing only a portion of the formation. Scattered elsewhere we find ledges of the Black Hand, the lower part of the formation being frequently covered by talus slopes or by flood-plain deposits, while its contact with the overlying Logan is generally hidden by products of weathering. In a few places the highways crossing sharp elevations

have so directed the run-off water of showers as to reveal the strata, but seldom forming a section that will admit of precise measurement. In general the uplands and slopes have a coating of residual material, while aggraded valleys prevail elsewhere. These conditions therefore have precluded any great



1. W-E SECTION THROUGH NORTH END OF TOWNSHIP
2. W-E SECTION THROUGH REFORM
3. W-E SECTION THROUGH SOUTH END OF TOWNSHIP
4. N-S SECTION THROUGH PLEASANT HILL CHURCH

PLATE 2

accuracy in obtaining vertical sections of rock structure. Nevertheless we feel that the data obtained adds something to published reports on the stratigraphy of the immediate region.[1]

The thickness of the formations, as well as the vertical range of dissection, was established by the barometer, the var-

[1]Rep. Geol. Surv. Ohio, vol. iii, Pt. I, 1874. pp. 349, 352.

iations of which were checked up by another instrument kept at a given base in the area being worked and read hourly or oftener; that the two aneroids when kept together varied alike had been ascertained previously.

The following formations occur in the township:

(4) Sharon conglomerate. (2) Black Hand formation.
(3) Logan formation. (1) Cuyahoga formation.

In most cases the lithological distinction of the formations is sufficiently marked to establish lines of contact; whenever doubt arose the question was further investigated by seeking characteristic fauna.

1. CUYAHOGA FORMATION. The Rocky Fork crosses the northwest corner of Perry township, flowing southward through Mary Ann township till within a mile of the southern boundary where it swings eastward cutting the southwest corner of Perry. Only in this latter part of its course does the stream flow on rock, which is the Cuyahoga. At several points along the bed are ripple marks, the best illustrations being just south of the swing foot-bridge over the stream near the point of its turn westward into Mary Ann township. The lower three feet of section shown in Fig. 1, consisting of blue shale and thin sandy layers, belongs to the Cuyahoga.

The broad valley in which Perryton lies, (Fig. 2), and the valley extending south from Reform, evidently are floored in the Cuyahoga. The relative great width of the former valley in the region referred to is due in part to another cause considered later.

2. BLACK HAND FORMATION. In the area studied the maximum thickness of the Black Hand is 110 to 115 feet; this is attained in the southern part of the township; the formation apparently thins northward. At Haven's quarry and down Quarry run southeast of Newark Professor Prosser measured 100 1-2 feet of Black Hand[1]; one-half mile east of Claylick Professor C. L. Herrick reported "about 100 feet of alternating

[1]The Am. Geologist, vol. xxxiv. 1904, p. 359.

conglomerate and coarse sandstone of prevailingly red color,"[1] a description which closely characterizes the formation as it appears in Perry township, and a thickness which Professor Prosser verified in the vicinity of Claylick[2].

From the highways of Perry township the coarse conglomerate horizon of this Black Hand formation is the most striking lithological feature. Along the "Newark Road" (Fig. 3) from Perryton towards Hanover, and along the roads bearing northward to Fallsburg and Reform it stands out in cliffs revealed by lateral planation of the older drainage lines.

Both above and below this conglomerate horizon we find thiner bedded buff sandy layers, which weather into gentle slopes in accord with the overlying Logan slopes (Fig. 2). But wherever the Black Hand contains 10 feet or more of the conglomerate phase, a break is noticed in this slope.

In the central part of Licking county Professor Herrick[3] found that this formation dips to the south about 14 feet, and to the east about 18 feet per mile. In determining the eastern dip he made his computations from a line of precise levels, using as a base Conglomerate I[4]. The work in Perry township done with two barometers is not so exact; our readings give an eastern dip of nearly 13 feet, and a southern dip of about 18 feet per mile.

In the eastern part of the county, Conglomerate I, which Professor Herrick used as a base is not constant in texture as in the central part; it is not sharply marked because the whole formation is often largely conglomerate. Therefore in ascer-

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[1]Bull. Sci. Lab. Denison Univ., vol. ii, 1887, p. 15.

[2]*Loc. cit.*, pp. 360, 361.

[3]Bull. Sci. Lab. Denison Univ., vol. iii, p. 24.

[4]Herrick considered Conglomerate I as the base of the Black Hand. In speaking of the section exposed in Quarry run and on Stasel Cliff east of Newark, Prosser says: "coarse grained buff sandstones extend for about sixty feet below the base of Conglomerate I, at which horizon is the most marked lithologic change in the rocks, and the base of these sandstones has been selected as the line of division between the Black Hand and Cuyahoga formations." (The Am. Geologist, vol. xxxiv, 1904. pp. 359-360).

taining dip we were guided usually by the contact with overlying Logan. The eastern dip which is lower in Perry township than a few miles west may be due to proximity to the axis of the Claylick anticline.[1]

3. LOGAN FORMATION. The greatest thickness of the Logan, measured in the southern part of the township, is about 120 feet; this formation also appears to thin northward. In texture the Logan here accords with the descriptions found in the literature.[2] It was noted, however, that in the upper layers many ironstone concretions appear; in two localities thin beds of ferruginous shale outcrop.

When the overlying Pottsville does not appear in the usual coarse conglomerate phase, its contact with the Logan is not sharp. In ascending a section of the Logan, the presence of nodulary iron masses denotes proximity to the Sharon member of the Pottsville.

On the hill road running northwest from Perryton is found perhaps the most accessible section of the Logan in the township. Here it is 79 feet thick, aneroid measurement, the top of the Black Hand being found at the first house to the north after descending the west slope No stream-made section of the Logan was noted; but it is surface rock along nearly all highways leading away from the Wakatomaka valley.

4. POTTSVILLE FORMATION. Commencing with the Sharon conglomerate overlying the Logan, we have measured 225 feet of Pottsville. In ascending order the formation may be described thus: A conglomerate, locally called "peanut stone," with quartzite and other pebbles sometimes very coarse; in northwest part of the township near the Rocky Fork, conglomerate units weighing about two and one-half pounds were found. Fire clay overlain by shale beds frequently carbonaceous follows; then come sand and shale layers with iron nodules followed often by white micaceous sandstone. In one place, on the farm

[1] Bull. Sci. Lab. Denison Univ., vol. iii, p. 24.

[2] Prosser. Jour. Geol. vol. ix, 1901, pp. 230-231.
Andrews. Geol. Surv. Ohio, Rept. Prog. (1869), Part II. p. 76.

of Samuel Wise, a little east of Claggett's Hill, was noted a fourteen inch seam of coal which has been worked some; succeeding this in vertical section are fire clay, thin bedded sandy layers, and, 25 feet above the coal seam, in Mr. Wise's cellar (a house just constructed) a "coal blossom." On elevations above this point conspicuous conglomerate strata, but not so coarse as much of the Sharon, again appear; this second horizon of conglomerate, if not too local in distribution, might mark one boundary of another member of the Pottsville formation, to the upper part of which the Ohio Survey has not given final classification[1].

In the hill region south of Perryton carbonaceous shales were also noted below the Sharon conglomerate, which in this locality forms a pronounced escarpment (Fig. 4).

The maximum thickness of the Pottsville in Perry township is about 225 feet. The highest and lowest beds of the formation are conglomerate; the succession of intervening layers is not constant.

SUMMARY. In character the rocks of this township are prevailingly coarse. Streams from the Logan areas deposit some clay, but sandy highways are the rule. The two marked conglomerate phases, the Black Hand and the Sharon, stand out as shoulders in the degraded slopes.

Careful search was made for any trace of the Maxville limestone. In a few places a hard, fine-textured rock, light in color, was found at the proper horizon for the Maxville; but in most cases the rock gave no response to a lime test; in only two instances was there even a slight effervescence.

TOPOGRAPHY.

The region is maturely dissected; nowhere can one find a mile of unbroken divide. For the most part the surface is cut up into contiguous inverted bowl-like topography. The method of degradation which has produced this result is probably complex; the same weathering agents at work elsewhere in a

[1]Prosser. Bull. Geol. Surv. Ohio, Fourth Series, No. 7 (1905) p. 13.

similar climate have not always given like surface features. The stratigraphy of the area has been the important control in the topographic effects of weathering.

In the rocks of this area chemical weathering evidently has been active ever since the appearance of vegetation to decay. Silica is the only cement noted in the sandstones and conglomerates. Along the outcrops of the Black Hand and Sharon, "honey combed"[1] surfaces (Fig. 5), and pronounced reentrant angles in lines of major joints, show the corrosive work that is being done today. In the Black Hand one mile south of Reform, and in the Sharon three miles south of Perryton, masses of rock thirty to forty feet in maximum length and ten feet or more in width have been detached and are working down the slopes because of the widening of major joint planes slightly oblique and parallel to face of cliff, the exposed surface becoming the face of the new escarpment (Fig. 6).

Since sandstone is so common, and so irregular in its bedding, there is no uniformity in position of the water table. Springs appear on the surface with little system. These springs have rendered the slopes quite uneven; apparently they have had an important part in bringing about the prevailingly crenate form of divide.

The angle of surface slopes generally reveals the rock formation present. The Logan slope is typical; while the sharper declines mark position of the coarser rock structures. The gentler slopes of the former (Fig. 7) are often dotted with blocks of the latter which are slowly weathering as they creep down the grade.

The major valley of the township is occupied by the Wakatomaka Creek which flows from the south central part northward, then at an angle of some forty degrees east of north continues past Perryton entering Muskingum county. Two tributary valleys from the north enter this valley, one heading in the Claggett's hill area, locally called the "Highlands," the other reaching into Fallsbury township. The valley of the

[1]Andrews. Loc. cit. p. 76.

Rocky Fork, crossing the township twice, has already been alluded to. A tributary stream comes from the south joining the major valley near Perryton.

These valleys are not uniformly concordant, a condition discussed under Drainage. We do not know the exact depth to which they have been incised. An altitude of about 400 feet was measured between the greatest elevation, Claggett's Hill, and the lowest flood-plain, the point where the Wakatomaka leaves the township. But the present vertical range in altitude falls much short of representing the maximum work done by erosional factors. We have no borings giving complete cross-sections of the drainage lines, therefore the exact depth of their aggraded materials cannot be stated.

Weathering and degradation have proceeded so far that we have no long ridges or divides. Conditions inherent in the stratigraphy, important among which is the variation in rock texture along both vertical and horizontal lines, have aided in accomplishing the topographic features described.

GLACIATION.

All evidence found points to the conclusin that ice never moved into this township from the west, north, or east. We find columnar remnants (Fig. 8) of once continuous escarpments that could not have withstood the over-riding of ice. Residual soil in place is constant on slopes exposed to ice moving in from any of these directions (Fig. 9). We find no foreign boulders that could have been brought in by ice, except in southwest corner of the township in the flood-plain material along the Rocky Fork. Furthermore the valley filling of the streams is local.

In the south central part of the township is glacial-carried deposit; this accumulation is continuons with the drift about Hanover. Towards its northern margin this drift area is made up of assorted materials as if deposited by water moving rather freely in the direction of Perryton; in this marginal section we do not find any immediately ice-front drift, or till; and the drift thickens as we go southward in the direction of Hanover. The

evidence points to the existence of a tongue of ice extending from the vicinity of Hanover northward, reaching possibly a mile into Perry township. Furthermore there is evidence of one, and possibly two halts of this ice-tongue.

DRAINAGE.

Since drainage problems are seldom localized, little can be accomplished in considering the drainage of a restricted area. But in this region of about 25 square miles we find one or two points that will be of use in investigations including adjacent territory.

The major stream of the township, the Wakatomaka, rises in the drift just considered; its headward work is slight save that accomplished through heavy rains and at flood seasons. At two places only is it on or near rock (Plates 3 and 4). It occupies a valley cut down possibly into the Cuyahoga; this valley is irregular in width; for about a mile either way from Perryton it is very mature, being constantly a mile and sometimes one and a half miles wide. Northeast of Perryton the valley, swinging into Muskingum county, narrows. Near the county line this branch of the Wakatomaka joins another arm which rises near Bladensburg, Knox Co. The Wakatomaka is a tributary of the Muskingum river, uniting with it at Dresden.

From the north the Perry township arm of the Wakatomaka receives several tributaries; the largest of these flows from the central part of Fallsburg township, another rises north of Reform. Both the major stream and these tributaries have flood-plains, and present other evidences of an advanced stage in the erosion cycle.

Plate 3 gives a detail of drainage about one mile south of Reform. The Black Hand cliffs exposed attain a maximum height of 32 feet; we have here the coarse conglomerate phase of the formation. From all evidence available these cliffs, produced by steam work, weather slowly. North of the highway on the east, the patched appearance of this outcrop is due in part to talus from the overlying Logan; while the two isolated

rock areas just south of this road evidently are remnants from stream erosion.

A recent well boring at 1, on the farm of C. E. Smith, throws much light on the shape of the valley floor here. This boring passed through 198 feet 10 inches of stream gravels (as reported by the owner) before reaching rock; it stands 296 feet from the cliff M, and is 574 feet from the rock remnant, N. The

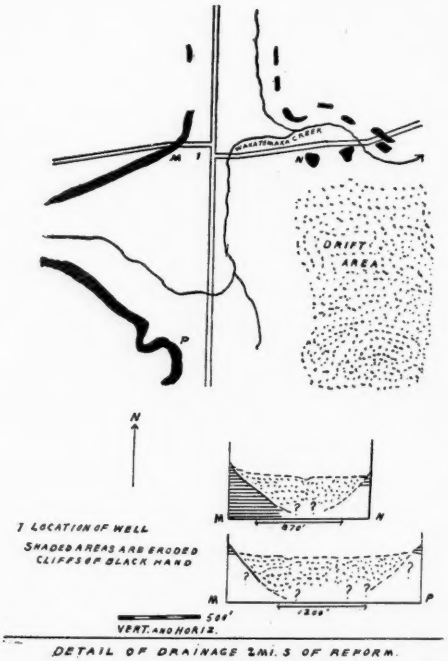


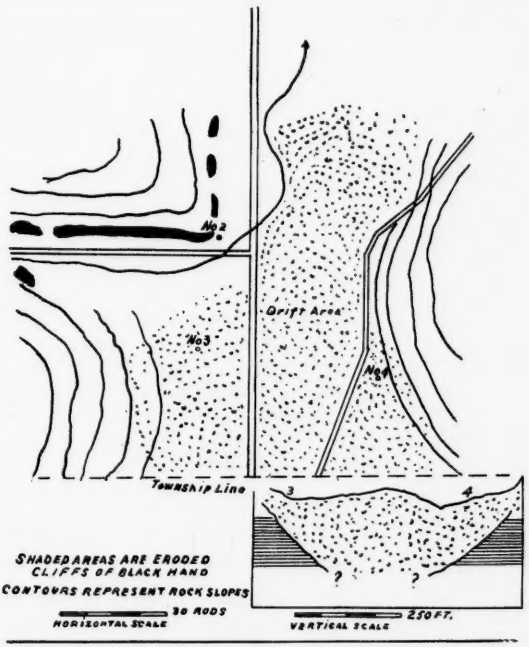
PLATE 3

upper cross-section through M-N is drawn according to these figures; while the lower cross-section is drawn through M-P, the mouth of the tributary valley from the west.

Cliffs of the Black Hand conglomerate, in one place on west side of valley 40 feet high, appear in patches on the way north to Reform. But these lines of cliffs do not converge reg-

ularly northward ;this valley swells and contracts as already noted in the major valley.

Cliffs of the same formation lie just west of the road leading south towards Hanover. Proceeding in this direction, at the next highway which turns west, we find a repetition of the conditions recorded west of the north-south road in Plate 3. But here the valley coming from the west is not so mature; its eastward flaring cliffs of conglomerate, while not so far apart,



DETAIL OF DRAINAGE JUST SOUTH OF PLATE 3

PLATE 4.

are as high as in the case above; and within one-half mile of the north-south road the brook which now occupies this valley cascades, marking the limit of dissection of the Black Hand in this direction. We have here also, in a position corresponding to the location of the well in Plate 3, on the farm of Z. H. Mc-

Knight a well (No. 2 in Plate 4), standing about 50 feet east of the cliff, which reaches rock after passing through 81 feet of aggraded materials. It is evident that the rock wall here drops off rather sharply, a repetition of the gorge characteristics illustrated in the cross-sections of Plate 3.

At the second house south of well No. 2, Mr. McKnight has driven another well which reaches rock at 78 feet; this well, marked No. 3 on Plate 4, stands a few rods farther west than does No. 2. On the next highway east is well No. 4, nearly in an east-west line with No. 3, on the property of H. S. Montgomery. After going through 129 feet of gravel, sand, and clay this well reaches rock.

The curb of No. 2 is 65 feet below the crest of the drift to the east; that of No. 3 is 35 feet below, while No. 4 stands about 18 feet lower than the top of the drift. Plate 4 gives a cross-section of the valley passing through wells 3 and 4, showing the probable outline of the valley floor. The great mass of drift here shown is a continuation of Leverett's Hanover Dam.[1] In the valley included in the region of these wells, stream erosion has exposed in the drift a measurable thickness of 90 feet; this depth with the record of No. 4 gives the drift an established thickness of 147 feet. But the drift here is presumably much thicker since it occupies a valley the rock walls of which, at this point 240 rods apart, flare southward into a wider valley, an old drainage line which Tight[2], in his work on restored drainage, connects with the Scioto basin.

We have here, then, an obvious instance of drainage re-

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[1]U. S. Geol. Surv., Monograph xli, p. 260, and p. 286.

[2]Bull. Sci. Lab. Denison Univ., vol. viii., part II, p. 47.

Speaking of the old east-west valley Tight says, on page 43: "The line of Waverly hills . . . . . , which form the northern wall of this broad valley, ... , can be traced as an unbroken ridge to the east. . . . . It is divided north of Hanover by Rock Fork Creek and north of Frazersburg by Wakalomaka Creek, both small streams with narrow V shaped valleys." No mention is made of the broad buried valley from Perryton coming into "this pre-Glacial stream, for which the name Newark River is suggested." (This last quotation is also from Tight, Professional Paper, No. 13, U. S. G. S.. p. 18.)

versal; and an equally obvious cause for the reversal is suggested in the glacial dam.[1] Although the drift deposits completely fill the valley at the point of its debouchure into the broader east-west valley, thus affording the requisite conditions for a ponded water body that would rise to a spill-way somewhere about its rim, yet a field study of the basin that must have been involved in such a static body suggests the advisability of considering other causes that might produce the same reversed drainage.

The tributary valleys of this hypothecated lake-basin were favorable to the formation of deltas; but no deltas exist anywhere about the basin. The irregularly dissected shores furnish numerous profiles to register wave work in the formation of cliffs and bars; but we find neither. The absence of clays suggests that a lake could have existed here but a short time, if at all. Furthermore the valley-train frontal appearance of the drift area, which constitutes the glacial dam, is evidence pointing to the same conclusion as does this absence of shore phenomena.

Whatever cause has effected the reversal, the stratigraphy of the area has been an important control in the working out of that cause. The original horizontal beds in this part of the State are undisturbed save for broad low folds decreasingly characteristic as we come westward from the axis of the Appalachian movement. In vertical section, however, (Plate 2,) the formations in eastern Licking county at least are sharply different in texture, hence in capacity to resist denudation.

The Sharon conglomerate apparently marks the limit of down-cutting reached in the Cretaceous base-level cycle. This formation is underlain by the thin bedded sands and sandy shales of the Logan. Stream erosion was held up by the coarse silica-cemented Sharon, but after this conglomerate horizon had been incised, erosion proceeded more easily in the Logan; and through planation the Sharon cliffs were undercut thus widen-

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[1]Clark, W. B. Bull. Sci. Lab. Denison Univ. vol. xii, p. 8.

ing the stream valleys. Further cutting in the Logan developed easy slopes down which Sharon blocks are still creeping.

And erosion was again retarded whenever encountering the coarse phase of the Black Hand conglomerate, the phase that predominates in Perry township.[1]

Still another factor has had much to do, as already intimated, in producing the present drainage topography: These conglomerate and coarse sandstone horizons lack homogeneity in both vertical and horizontal sections. Since the maximum thickness of either formation is not over 225 feet, the vertical changes in texture are not of controlling importance; but the variations in horizontal extension is important. This control is manifest in the short and disproportionately wide tributaries, in the contraction and expansion of valleys, in the distinct variations in angle of slopes, and in the crenate form of divide.

Therefore the fact that a tributary is as wide or even wider than the major valley, and that a stream is flowing through a narrow reach in a valley which broadens both up and down stream, may or may not be evidence of drainage reversal. Such a relationship of valleys, or of streams to their valleys, may be the normal result of drainage development in the lower Carboniferous.

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[1]In the central and western parts of Licking county the Black Hand formation is finer in texture and contains more thin layers; this condition is noted in quarries about Newark and Granville.

Fig. 1. A section along the Rocky Fork in southwestern part of Perry township, marking contact of the Cuyahoga and Black Hand formations. The lower 3 feet is Cuyahoga.

Fig. 4. Disintegration of the Sharon. This view is in an escarpment, over a mile long, the result of differential weathering.

Fig. 2. Looking north over Perryton. A typical Logan slope shows in the foreground. The broad flat area is a local expansion in the Wakatomaka valley, a section where the rocks have yielded readily to lateral planation.

Fig. 3. Looking west through the converging cliffs of the tributary valley next to well No. I; only the southern rock wall shows conspicuously. Cross-section M-P is drawn through the foreground.

Fig. 5. The work of solution in the Sharon conglomerate, a characteristic form of weathering observed in these coarse formations. Lichens also show here.

joint plane. The mass on the left is gradually creeping.

Fig. 6. Looking through an opening about 40 feet long in the Sharon Conglomerate; this marks the position of a major joint plane. The mass on the left is gradually creeping.

Fig. 7. This Logan slope strewn with Sharon blocks is on the north wall of the Wakatomaka Creek a short distance over the Perry township line in Muskingum Co.

Fig. 8. Columnar remnants that could not have withstood ice-abrasion.

Fig. 9. A highway-cut, about 65 feet below the highest point of Claggett's Hill, in residual soil; in upper part of Section is a block which has crept down from above.